A COMPACT SAMPLING DEVICE FOR ECOLOGICAL STUDIES OF CRYPTOZOAN COMMUNITIES[1]

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ABSTRACT: A compact sampling device constructed from discarded beverage containers is described for use in ecological studies at remote field sites. Environmental conditions within sampling units do not differ from leaf-litter microhabitats. Individuals of various cryptozoan groups are generally distributed at random in both time and space in sampling units. The procedure is as effective as quadrat sampling in determining relative abundances for centipede communities.

Ecological studies of soil and litter arthropods ("cryptozoa", cf. Cole, 1946) are generally based on absolute density measures obtained from quadrat sampling techniques (reviewed by Wallwork, 1970), or from data obtained by relative methods such as pitfall trap collections (Uetz and Unzicker, 1975). These methods involve numerous, bulky sample units that present logistical difficulties for studies in remote areas. More convenient sampling methods would be useful for analyses of community structure.

A primary objective of community studies of cryptozoa is to determine the relative abundance of species within the leaf-litter microhabitat. Any alternative collection method must sample this microhabitat with the same efficiency as conventional procedures. In addition, the sampling units must (1) all have an equal chance of collection, (2) have stability throughout the sampling period, and (3) sample a constant proportion of the target populations (Morris, 1955). The following material describes a compact unit for sampling cryptozoan communities. We report the collections for various taxa and compare the efficiency of the proposed method with quadrat sampling of centipede communities.

Sampling units were made from 355 ml (12 oz) tin beverage containers with the ends removed. All containers were thoroughly scrubbed to remove residue and allowed to air-dry before placement in the field. Preliminary studies of the sampling unit were conducted in a dry uplands forest at Robert Allerton Park, Piatt Co., Illinois. Units were placed in six blocks of a randomized-blocks design. Each block consisted of a 6x6-m plot subdivided into 36 compartments. Sampling units were packed loosely with leaf litter and placed on the ground in each compartment of every block. Units in three blocks were collected after 4 weeks, but only ten centipedes were collected.

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The remaining three units were left for 10 weeks.

After 10 weeks in the field, six sampling units in each block were randomly selected for collection at each of six times during a 24-hr period (0200, 0600, 1000, 1400, 1800, and 2200 hrs). At the time of collection, each unit was placed in a plastic bag, labelled, and taken to the laboratory for Berlese funnel extraction of all arthropods. Ten 0.1m^2 litter samples were also collected in each block for Berlese funnel extraction.

Sampling units were covered with leaf litter in order to prevent disturbance and to reflect the environmental conditions of the leaf-litter microhabitat as closely as possible. Temperature readings during a 24-hr period were taken on three separate occasions. Temperatures in the sampling units never differed from adjacent leaf-litter temperatures by more than 1.5 C and the two temperatures were highly correlated ($r=.991$, $p<.001$). This suggests that the artificial nature of the environment within sampling units is not greatly different from environmental conditions in undisturbed litter.

The number of individuals of various cryptozoa collected by these sampling units is presented in Table 1. These data are used to analyze spatial and temporal components of the collection process. It is possible that individuals of a taxon might have been attracted to some sampling units or that some of the units might have been placed in areas where individuals aggregated for other reasons. Either of these conditions would be indicated if the variance: mean ratio for the number of individuals per unit was significantly greater than one. The significance of variance: mean ratios can be tested against chi-square with one degree of freedom (third column of Table 1). Significant clumping of individuals in units occurred in collembola and ants, but not in roaches, millipedes, centipedes, or spiders.

Field studies of cryptozoan populations generally show contagious

TABLE 1. Number of individuals of several cryptozoan groups collected by a compact litter-sampling device ($n = 108$).

Group	Number of individuals collected	Mean no. of individuals per unit	P for random distribution among units	P for uniform distribution in time
Collembola	2,530	23.65	$<.0005$*	$.10 > p > .05$
Roaches	52	0.49	$.90 > p > .80$	$.20 > p > .10$
Millipedes	55	0.51	$.20 > p > .10$	$.60 > p > .50$
Ants	6,331	59.17	$<.0005$**	$.80 > p > .70$
Centipedes	77	0.72	$.25 > p > .20$	$.60 > p > .50$
Spiders	266	2.49	$.20 > p > .10$	$.50 > p > .40$

* χ_1^2 for the distribution of individuals among sample units for this group is 136.93

** χ_1^2 for the distribution of individuals among sample units for this group is 542.72

distributions in association with environmental features. However, the degree of aggregation appears to be strongly correlated with population density (Usher, 1976). Collembola and ants were collected in much greater numbers than any other group and have variances that are considerably greater than their means. Ant aggregation is a social phenomenon. Aggregations of collembola appear to be influenced by water and food sources (Verhoef and Nagelkerke, 1977). Furthermore, collembola secrete aggregation pheromones (Mertens and Bourgoignie, 1977; Mertens *et al.*, 1979). Aggregations of the other taxa probably occur in association with features not detected by the sampling device. In any event, these taxa do not appear to be attracted to the sampling unit and are sampled at a constant level.

An analysis of matched sets of sampling units at each of the six sampling times indicates no significant difference in the number of individuals collected at various times of day (Friedman's one-way analysis of variance by ranks, significance noted in Column 4 of Table 1). Thus, sampling units do not vary in efficiency with time of collection.

The efficiency of this sampling unit in studies of centipede community structure is compared to quadrat sampling in Table 2. These data indicate that centipedes collected by compact sampling units occur in the same relative frequencies as those obtained by Berlese funnel extraction from quadrat samples. This impression is confirmed by a contingency table analysis of species abundances (*Lithobius forficatus, Strigamia branneri, Schendyla nemorensis,* and *Geophilus vitattus* abundances are combined to conform to Cochran's rule [Zar, 1974:50]; $X_3^2 = 2.685$; $.50 > p > .40$).

The results of this preliminary study indicate that the compact sampling unit described here is as effective as conventional procedures in assessing species richness and relative abundances in leaf-litter microhabitats. If units are covered with leaf litter and left in place for at least 10 weeks, the

TABLE 2. Centipedes collected at various times of day by a modified litter-sampling device in a dry, uplands forest. Specimens collected by Berlese funnel extraction of $0.1 m^2$ litter samples (n=30) are noted in the right column.

	Time of Day							
Species	0200	0600	1000	1400	1800	2200	Total	Quadrat
Nadabius ameles Chamberlin 1944	7	6	6	8	7	7	41	10
N. iowensis (Meinert 1886)	3	4	6	4	-	-	17	8
Neolithobius voracior (Chamberlin 1912)	3	1	1	2	1	1	9	4
Strigamia branneri (Bollman 1888)	1	2	3	-	-	-	6	4
Lithobius forficatus Linnaeus 1758	-	2	-	-	-	-	2	0
Schendyla nemorensis (C.L. Koch 1836)	1	-	-	1	-	-	2	0
Geophilus vitattus (Say 1821)	-	-	-	-	-	-	0	3
TOTALS	15	15	16	15	8	8	77	29

sampling device meets the criteria of stability and equiprobable colonization by target populations. This unit would be useful for ecological studies of cursorial litter-inhabitants in sites with features that make conventional methods unsuitable.

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